Remarks

The following numbered paragraphs are provided to respond to the similarly numbered paragraphs in the Office Action (e.g., paragraph "1" below corresponds to paragraph 1 in the Office Action.

As an initial matter, Applicant notes that the Office Action rejected each of claims 1-16 and 18-41 as either anticipated or obvious and did not reject claim 17. Upon reviewing claim 17 Applicant believes that claim 17 is similar to claim 1 and therefore that the Examiner intended to reject claim 17 as anticipated – the following response assumes that the Examiner intended to reject claim 17 as anticipated for the same reason that claim 1 was rejected.

1-2. The Office Action rejected each of claims 1, 2, 3, 15, 16, 18, 29, 40 and 41 and presumably claim 17 as anticipated by Lipo (4,724,373). Applicant has deleted claims 40 and 41. With respect to the other claims rejected as anticipated, Applicant respectfully traverses this rejection.

With respect to claim 1, claim 1 requires, among other things, (1) mathematically combining feedback current values to generate an error value and (2) mathematically combining the error value and the torque reference value to generate a torque command value. For example, referring to Fig. 2 of the present specification, estimator 70 and summer 56 combine the feedback currents i_{qsfb} and i_{dsfb} to generate error signal T_{err} (i.e., the first mathematical combination). Thereafter, summer 60 adds error signal T_{err} to reference signal T_{ref} (i.e., the second mathematical combination) to generate the torque command signal T*. Here, signal T_{err} is clearly an error signal in the sense that it is the difference between an actual torque estimate value T_{est} and the reference torque value T_{ref}.

In contrast, referring to Lipo and specifically to Lipo's Fig. 9, Lipo teaches that calculator 110 identifies a "measured" torque value T_e (see col. 10, lines 34-38) that is provided to summer 112 where summer 112 subtracts the measured torque value T_e from a command torque value T_e*. The measured torque value T_e is not an error value but instead is akin to a torque estimate. Instead Lipo's error value is generated by Lipo's summer 112 (see Lipo's col. 10, lines 37-39 that states

"[S]ummer 112 which subtracts the measured torque T_e from the reference torque T_e^* to provide an error output signal on a line 113."). Clearly in Fig. 9 as in the Lipo specification generally, Lipo does not mathematically combine the error on line 113 with the torque reference value T_e^* as required by claim 1.

Because Lipo fails to teach combining an error value and the reference torque value, Applicant believes claim 1 and claims that depend therefrom are patentable over Lipo.

With respect to claim 3, claim 3 depends form claim 1 and further requires that the second mathematical combining step include adding a derivative of the error value and a derivative of the torque reference value to generate the torque command value. Here, the term "derivative" is used in a general sense to refer to any derivation from an initial value. To this end, the present specification states in paragraph 34 that, "In addition, note that the term "derivative" is used herein to refer to two different mathematical concepts and that the context of the text in which the term appears should be used to determine which of the two meanings should be applied. First, derivative is used to refer to a change with respect to time as in Equations 2 and 3 below. Second, in some cases, the term derivative is used to refer to any derivation from an initial value. For instance, applying a proportional or proportional-integral gain to an initial value may result in a derivative of the initial value. (Emphasis added).

Referring to Lipo's Fig. 9, even if the output on line 111 from calculator 110 were some how construed as being an error value which it is not, summer 112 clearly subtracts the value on line 111 from the command torque value T_e^* without either of the values being manipulated prior to combination (i.e., neither of the torque command value T_e^* or the value on line 111 is manipulated in any fashion prior to summer 112). For this additional reason Applicant believes claim 3 and claims that depend therefrom are patentable over Lipo independent of the reasons for patentability described above with respect to claim 1.

With respect to claim 17, claim 17, claim 17 includes, among other things, a processor that performs each of the first and second mathematical combining steps of claim 1 to generate the error value and the torque command value, respectively. For the same reason that Lipo does not anticipate claim 1, Lipo also does not

anticipate claim 17. More specifically, Lipo fails to teach or suggest and indeed teaches away from mathematically combining an error signal and a reference or command signal to generate a command torque signal.

With respect to claim 29, claim 29 requires, among other things, an estimator for mathematically combining feedback currents to generate an error value and a regulator for mathematically combining the error value and a torque reference value to generate a torque command value. Thus, claim 29 includes structure that performs both of the mathematical combining steps of claim 1 and thus is not anticipated by Lipo for the same reason that claim 1 is not anticipated by Lipo.

3-4. The Office Action rejected each of claims 3-14, 19-28 and 30-39 as obvious over Lipo. Applicant traverses this rejection. As an initial matter, each of claims 3-14, 19-28 and 30-39 depends from one of claims 1, 17 or 29 and therefore is patentable through dependency for the reasons described above.

Also, prior to discussing other rejected claims, Applicant notes that the claims and the equations expressed in the claims are very specific and have been identified as optimal or at least suitable in many application only after the realization that conventional control equations used to describe control systems can be expressed differently in terms of operating values that are relatively easy to obtain during operational control. To this end, Applicant points out that Equation 1 in the present application is identical to the equation in col. 8, lines 61 of Lipo but that thereafter the equations diverge with the present specification developing Equation 5. The text directly after Equation 5 in the present specification makes clear that the variables in Equation 5 are easy to obtain. Lipo develops different equations which are not as easy to obtain and/or result in different quality of torque control. Similarly Equations 12 and 13 in the present specification have been developed to facilitate high quality torque control using easily obtainable values. Thus, the preferred equations in the present case are not simply a matter of designer choice but rather are related to the end results intended to achieve – i.e., easy to implement high quality torque control.

Turning now to the rejected claims, with respect to claim 4, claim 4 depends form claim 1 and further requires that the step of mathematically combining the currents to generate the error value includes combining the currents to generate a

currents to generate the error value includes combining the currents to generate a torque estimate and subtracting the torque estimate from the torque reference value to generate the error value. Referring again to Lipo's Fig. 9, while calculator may combine currents to generate a torque estimate and summer 112 may subtract the estimate from a reference or command value as required by the limitations added by claim 4, the resulting error value is not further mathematically combined with the torque reference value (i.e., the second mathematically combining step) of claim 1.

With respect to each of claims 5, 8, 11, 21,24, 32, 35 and 38, each of those claims further requires, among other things, determining the operating frequency of the machine and using the operating frequency to derive other values needed to generate the torque estimate. Applicant has examined Lipo in detail and notes that Lipo the Lipo specification never uses the term "frequency" or a term akin thereto. For this reason Applicant believes that Lipo cannot possible teach or suggest identifying a machine operating frequency, much less using the operating frequency in the manner required by each of claims 5, 8, 11, 21,24, 32, 35 and 38.

With respect to each of claims 6, 22 and 33, each of those claims requires, among other things, using a stator resistance value to identify a torque estimate value Test. While Lipo discusses a stator resistance value, Lipo does not teach or suggest using a stator resistance value to estimate torque and indeed appears to suggest that the stator resistance value is irrelevant to operation of the Lipo invention (see col. 5, lines 16-18).

With respect to claims 9, 10, 25, 26, 36 and 37, each of those claims requires solving one of two specific torque error equations, neither of which is not taught or suggested by Lipo. For this additional reason Applicant believes that each of claims 9, 10, 25, 26, 36 and 37 is patentably distinct over Lipo.

With respect to each of claims 12, 19 and 30, each of these claims further requires that the second mathematical combining step include adding a derivative of the error value and a derivative of the torque reference value to generate the torque command value. Here, as in claim 3, the term "derivative" is used in a general sense to refer to <u>any derivation</u> from an initial value. Referring again to Lipo's Fig. 9, even if the output on line 111 from calculator 110 were some how construed as being an error value which it is not, summer 112 clearly subtracts the value on line

111 from the command torque value T_e^* without either of the values being manipulated prior to combination (i.e., neither of the torque command value T_e^* or the value on line 111 is manipulated in any fashion prior to summer 112). For this additional reason Applicant believes each of claims 12, 19 and 30 and claims that depend therefrom are patentable over Lipo independent of the reasons for patentability described above with respect to the independent claims.

With respect to each of claims 13 and 27 each of those claims requires converting the torque reference value into a power reference value, among other process steps. Lipo fails to teach or suggest conversion into power values to perform processes and therefore, for this additional reason, Applicant believes claims 13 and 27 are patentably distinct over Lipo.

Applicant has introduced no new matter in making the above amendments and antecedent basis exists in the specification and claims as originally filed for each amendment. In view of the above amendments and remarks, Applicant believes claims 1-39 of the present application recite patentable subject matter and allowance of the same is requested. No fee in addition to the fees already authorized in this and accompanying documentation is believed to be required to enter this amendment, however, if an additional fee is required, please charge Deposit Account No. 17-0055 in the amount of the fee.

Respectfully submitted,

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